REMARKS

By the present amendment, claims 1 to 9 are pending in the application.

Claim Amendments

Claims 1, 7 and 9

Support for the amendments to claims 1, 7 and 9 may be found in the specification, e.g., at page 8, lines 28 to 33; at page 9, lines 12 to 17 and lines 31 to 37; and at page 1, line 36 to page 2, line 5.

As is understood from the above, "operating swiveling component of the roll gap of the mill" means "operating the reduction leveling", and "the reduction leveling" means "control of a left-right difference of the roll gap of the rolling mill" (page 1, line 36 to on page 2, line 5).

On the basis of these descriptions, in order to make the meaning of the phrase "swiveling component of roll gap of said rolling mill" in claim 1 clear, this phrase is amended to --left-right difference of roll gap of said rolling mill--.

The phrase "a left-right swiveling component control quantity of roll gap of said rolling mill" of claims 7 and 9 is amended to --a left-right difference control quantity of roll gap of said rolling mill-- on the same basis explained above.

It is clear that left-right difference of roll gap of the rolling mill represents the difference of roll gap between the operator side and driving side.

Claim 3

The amendment to claim 3 is based on the description of the specification at page 13, line 25 to page 14, line 3. The rolling direction force acting on the roll chocks is calculated on the basis of difference of the measured value of the load detection device between the entry side and exit side of the roll chock.

Claims 1 and 3

Independent claims 1 and 3 have been amended to clearly specify that the work rolls are --flat rolled material-- work rolls and that the work rolls are --horizontal-- work rolls.

Independent claims 1 and 3 are directed to a method or apparatus for flat-rolled metal materials.

Horizontal work rolls are disclosed, e.g., in Figs. 1 to 4 of the specification.

§112, ¶1

Claims 1, 2, 7 and 9 were rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement. The Office Action objected to the phrase "a left-right swiveling component of roll gap of said rolling mill".

In response to this rejection, claims 1, 7 and 9 have been amended by the present amendment. The amendments to claims 1, 7 and 9 have been previously discussed.

In view of the present amendment to claims 1, 7 and 9, it is respectfully requested that the rejection of claims 1, 2, 7 and 9 under 35 U.S.C. §112, first paragraph, be withdrawn.

§112, ¶2

Claims 5 and 6 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

In response to this rejection, claim 5 has been amended to be dependent on claim 4 to provide an antecedent basis for "said device for pressing said work roll chock".

In response to this rejection, claim 6 has been amended to clarify the work roll offset.

In view of the present amendment, it is respectfully requested that the rejection of claims 5 and 6 under 35 U.S.C. §112, second paragraph, be withdrawn.

§102/§103

(a). Claim 3 was rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,089,196 to Kondo et al.

(b). Claims 3 to 6 were rejected under 35 U.S.C. §102(b) as being anticipated by Japan No. 06-269818 to Watanabe et al.

(c). Claims 1, 3 and 8 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,154,080 to Suzuki et al. in view of Japan No. 60-046812 to Furui et al.

(d). Claims 1, 3 and 8 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,089,196 to Kondo et al. in view of Japan No. 60-046812 to Furui et al.

(e). Claims 2 and 8 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,154,080 to Suzuki et al. and Japan No. 58-057891 to Furui et al. (application for Japan No. 60-046812 to Furui et al.) and further in view of Japan No. 07-214131 to Ogawa.

(f). Claims 2 and 8 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,089,196 to Kondo et al. and Japan No. 58-057891 to Furui et al. (application for Japan No. 60-046812 to Furui et al.) and further in view of Japan No. 07-214131 to Ogawa.

(g). Claim 8 was rejected under 35 U.S.C. §103(a) as being unpatentable over Japan No. 06-269818 to Watanabe et al. in view of Japan No. 59-110408 to Teruo.

These rejections are respectfully traversed.

There was no specific prior art rejection of dependent claim 9.

The Present Invention

The present invention provides:

1). A rolling method of a flat-rolled material, for executing rolling by using a rolling mill having at least flat-rolled metal material horizontal work rolls and backup rolls, comprising the steps of:

measuring rolling direction force acting on roll chocks on a operator side and a driving side of said work rolls;

calculating the difference of said rolling direction force between the operator side and the driving side; and

controlling a left-right difference of roll gap of said rolling mill on the basis of said calculated difference.

2). A rolling apparatus for a flat-rolled metal material including a rolling mill having at least flat-rolled metal material horizontal work rolls and backup rolls, comprising:

load detection devices for measuring rolling direction force acting on work roll chocks, arranged on both entry side and exit side of the roll chocks in the rolling direction on both operator side and driving side of said work rolls, and

a calculation device for calculating rolling direction force acting on said work roll chocks on the basis of difference of the measured value between the entry side and exit side of the said load detection devices.

The technical concept of the present invention is detecting moment causing camber acting on the material with high accuracy based on the difference of force acting on the work roll chocks on the operator side and the driving side of the rolling mill and reducing the camber by reduction leveling based on the result of the detection.

According to the present invention, it becomes possible to steadily and stably produce flat-rolled metal materials free from camber or having an extremely small camber without depending on the number of rolling passes.

Patentability

US Patent No. 4,089,196 to Kondo et al (US '196)

The rolling apparatus disclosed in US '196 has load detection devices arranged at both the operator side and the driving side.

However, the load detection devices of US '196 are for detecting tension acting between the stands in the continuous multi-stand rolling mill where bars and/or wires with an almost same ratio of width to thickness are rolled by using caliber rolls having concave portions.

As shown in Fig. 3 of US '196, the load detection devices are used for controlling the difference of position between the position of the rolled material and the position of center of the roll in the width direction having plurality of calibers in the width direction of the roll.

In addition, in the rolling apparatus of US '196, backup rolls are not required.

As explained above, the rolling apparatus of US '196 is for rolling rods and/or wires and not for flat-rolled materials.

Since the use of the rolling apparatus in US '196 is different, the problem to be solved, i.e., reduction of camber which is specified in flat-rolled materials does not exist in US '196.

Independent claims 1 and 3 have been amended by the present amendment to make clear that the method and apparatus of the present invention are directed to flat-rolled metal material rolling mill.

The rolling apparatus of the present invention is a rolling apparatus for a flat-rolled metal material with a large ratio of width to thickness including a rolling mill having at least work rolls and backup rolls and further comprising load detection devices for measuring rolling direction force acting on work roll chocks and a calculation device for calculating rolling direction force acting on said work roll chocks on the basis of the difference of the measured value between the entry side and exit side of the load detection devices.

Therefore, the rolling apparatus of US '196, which does not have a calculation device for calculating rolling direction force acting on the work roll chocks and backup rolls, is different from that of the present invention.

Further, the rolling apparatus of the present invention can detect moment causing camber acting on the rolling material with high accuracy based on the difference of force acting on the work roll chocks of the operator side and the driving side of the rolling mill.

On the other hand, the apparatus of US '196 is a rolling apparatus for rolling bars and/or wires by using caliber rolls having concave portions.

In rolling materials (bars and/or wires) by using caliber rolls having concave portions, since rotation of the material is restricted by the caliber, the moment cannot be detected with high accuracy.

As explained above, the constitution of the rolling apparatus of the present invention and US '196 is different with respect to each other. US '196 does not disclose or suggest the technical feature of the present invention, i.e., detecting moment causing camber acting on the material with high accuracy based on the difference of force acting on the work roll chocks of the operator side and the driving side of the rolling mill, and reducing the camber by reduction leveling based on the result of the detection.

JP No. 06-269818 to Watanabe et al. (JP '818)

JP '818 relates to a rolling mill capable of strong reduction rolling having work rolls and backup rolls.

In order to reduce inferiority in the form of the rolled materials caused by difference of the horizontal deflection of the upper and lower work rolls, JP '818 discloses a rolling apparatus having a means for detecting rolling direction force acting on the work roll chocks and a means for adjusting the position of work roll chocks in the rolling direction based on the detected value.

The rolling apparatus of JP '818 has load detection devices arranged on entry side and exit side of the work roll chocks and further a pressing device arranged on either one of the entry side and the exit side.

However, the rolling apparatus of the present invention requires the load detection devices to be arranged on both the operator side and the driving side of the rolling mill.

On the other hand, the rolling apparatus of JP '818 does not disclose or suggest arranging the load detection devices on both the operator side and the driving side of the rolling mill.

The constitution of the rolling apparatus of the present invention is different from that of JP '818 in the point of view of the arrangement of the load detection devices.

Further, the constitution of the rolling apparatus of the present invention is also different from that of JP '818 from the point of view that the rolling apparatus of JP '818 does not have a calculation device for calculating rolling direction force acting on the work roll chocks based on the difference of the measured value of the load detection devices.

Since the rolling apparatus of JP '818 does not have above two constitutional elements, (i.e., load detection devices arranged both the operator side and the driving side and the calculation device for calculating rolling direction force), the technical feature of the present invention of detecting moment causing camber acting on the material with high accuracy based on the difference of force acting on the work roll chocks of the operator side and the driving side of the rolling mill, and reducing the camber by reduction leveling based as the result of the detection cannot be performed by JP '818.

In addition, it is noted that the means for adjusting the position of work roll chocks in the rolling direction of JP '818, which has likeness to the pressing device of the present invention, is a device for moving the position of the roll chocks in the rolling direction in order to reducing the horizontal deflection of the upper and lower work rolls.

On the other hand, the pressing device of the present invention is a device for pressing the work roll chocks in the rolling direction (i.e., not moving the position of the roll chocks) in order to enhance accuracy of load detection on the operator side and the driving side, and therefore the function of the pressing device is different from each other.

US Patent No. 4,154,080 to Suzuki et al (US '080)

US '080 relates to a means for supporting roll chocks in the rolling mill stand.

The object of US '080 is to provide a rolling mill having a means for centering a roll chock in the roll stand housing, whereby clearances of the same width can be easily provided at the forward and rear side of the roll chock so as to put the tension measuring means in an effectively operative condition.

In order to present the roll chocks position from leaning, US'080 discloses force sensing devices for measuring a force in the direction of rolling (i.e., load detection device) arranged on the entry side and the exit side of the rolling mill.

However, the detection devices of US '080 are arranged only on the driving side of the entry side and the exit side of the rolling mill while according to the present invention, the load detection devices are arranged on both the operator side and the driving side of the entry side and the exit side of the rolling mill.

Further, US '080 does not disclose or suggest providing a calculation device for calculating rolling direction force acting on the work roll chocks based on the difference of the measured value of the load detection devices.

Moreover, the rolling apparatus shown in Figs. 7 and 9 of US '080 is a rolling mill having vertical rolls which is different from a rolling mill having horizontal rolls of the present invention.

Since the rolling apparatus of US '080 does not have above two constitutional elements, i.e., the load detection devices arranged on both the operator side and the driving side of the entry side and the exit side of the rolling mill and the calculation device for calculating rolling direction force, the technical feature of the present invention of detecting moment causing camber acting on the material with high accuracy based on the difference of force acting on the work roll chocks of the operator side and the driving side of the rolling mill, and reducing the camber by reduction leveling based on the result of the detection cannot be performed by US '080.

JP No. 60-46812 to Furui et al. (JP '812)

JP 58-057891 to Furui et al. will also be referred to as JP '812 because JP 60-46812 and JP 58-057891 are essentially the same. JP '812 discloses a tension meter provided at both the operator side and the driving side of the rolling mill.

The object of JP '812 is to provide a tension meter capable of measuring tension of the rolling material and of detecting difference of load with higher accuracy.

The tension meter of JP '812 detects tension acting between the stands of the continuous rolling mill as load acting in the direction perpendicular to the tension at both the operator side and the driving side.

However, the difference of the detected load in JP 812 is used for controlling the amount of off center (meandering) and not for camber control.

Further, JP '812 does not disclose or suggest providing a calculation device for calculating rolling direction force acting on the work roll chocks based on the difference of the measured value of the load detection devices.

Since the rolling apparatus of JP '812 does not have above two constitutional elements, i.e., the load detection devices arranged on both the operator side and the driving side of the entry side and the exit side of the rolling mill and the calculation device for calculating rolling direction force, the technical feature of the present invention that detecting moment causing camber acting on the material with high accuracy based on the difference of force acting on the work roll chocks of the operator side and the driving side of the rolling mill, and reducing the camber by reduction leveling based on the result of the detection cannot be performed by JP '812.

The object of US '080 and JP '812 are different from each other, and therefore, they cannot be combined.

Even if they are combined, since these references do not disclose or suggest the calculation device for calculating rolling direction force, the technical feature of the present invention of detecting moment causing camber acting on the material with high accuracy based on the difference of force acting on the work roll chocks of the operator side and the driving side of the rolling mill cannot be derived from US '080 and JP '812.

JP No. 07-214131 to Ogawa et al. (JP '131)

JP '131 discloses a rolling apparatus comprising a horizontal rolling mill having horizontal rolls and a vertical rolling mill having vertical rolls equipped at the upper stream side of the horizontal rolling mill, wherein load detection devices are attached to the left and right vertical rolls of the vertical rolling mill.

The technical feature of JP '131 is reduced camber by rolling reduction leveling of the horizontal rolling mill based on the output difference of the load detection device of the left and right vertical rolls.

On the other hand, the technical feature of the present invention is to detect moment causing camber acting on the rolling material with high accuracy based on the difference of force acting on the work roll chocks of the operator side and the driving side of the rolling mill and to reduce camber by the reduction leveling based on the result of the detection.

In the present invention, as shown in Figs. 1 to 4 etc., the load detection devices are provided with the work roll chocks of the horizontal work rolls.

Therefore, the technical concept of the present invention is different from that of JP '131.

Further, JP '131 does not disclose or suggest arranging load detection devices on both operator side and the driving side of the horizontal rolls of the horizontal rolling mill and providing a calculation device for calculating rolling direction force acting on the work roll chocks based on the difference of the measured value of the load detection devices of the present invention.

Since the objects of US '080 and JP '812 are different from that of JP '131, JP '131 cannot be combined with US '080 and/or JP '812. The present invention cannot be derived from these references even if they are combined.

JP No. 59-110408 to Teruo et al. (JP '408)

JP '408 relates to a method for correcting camber of the rolling material and discloses a camber detection device on the exit side of the rolling mill.

This rolling apparatus of JP '408 has vertical rolls for correcting camber of the rolling material on the exit side of the rolling mill. The camber detection device is provided for measuring input value to the vertical roll for correcting camber.

However, in the apparatus of the present invention, the measured value of the camber measurement device is not provided for direct use for camber control, but for learning the control target value based on the difference of rolling direction force between the operator side and the driving side of the rolling mill.

In the apparatus disclosed in JP '408, since the measured value of the camber detection device is directly used for camber control, quick response control cannot be performed due to the delay of time caused by the distance between the detection end (input) and the control end (output).

On the other hand, according to camber control of the present invention based on the difference of rolling direction force between the operator side and the driving side, since there is no distance between the detection end (input) and the control end (output), quick response control can be performed.

Further, according to the present invention, in order to revise roughness of roll surface changing with the passage of time, the measured value of the camber measurement device is used for learning the control target value based on the difference of rolling direction force between the operator side and the driving side of the rolling mill, and therefore, compared to JP '408, camber control with quick response and high accuracy can be performed.

As explained above, none of the cited references disclose or suggest the technical concept of a rolling method and apparatus for rolling a flat-rolled material using a horizontal rolling mill of the present invention, i.e., detecting moment causing camber acting on the material with high accuracy based on the difference of force acting on the work roll chocks on the operator side and the driving side of the rolling mill, calculating the difference of said rolling direction force between the operator side and the driving side and reducing the camber by reduction leveling based on the result of the detection.

Therefore, the present invention is different from that of the cited references and cannot be derived from the cited references even if they are combined.

It is therefore submitted that independent claims 1 and 3, and all claims dependent thereon, are patentable.

CONCLUSION

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed for issue.

Respectfully submitted,

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